

ESTABLISHMENT TECHNIQUES FOR WOODY VEGETATION IN RIPARIAN ZONES OF THE ARID AND SEMI-ARID WEST

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Many riparian areas throughout the west are in need of rehabilitation. Abuses in the past have caused the native vegetation to be destroyed, the streambank banks to erode, and natural geologic erosion to accelerate. The relatively new emphasis on water quality, identification of the lost aesthetic value, negative affects on wildlife, and the destruction of fisheries habitat of these riparian areas has prompted new interest in methods to revegetate eroding stream channels especially in the arid and semi-arid West.

Planning Considerations

As with all projects, careful planning and consideration before planting is necessary to ensure that the fix doesn't create more problems than are already present. Stream and river systems are very complex. There are often strong reasons why willows are not already growing in the stream sections you have selected for rehabilitation. Water hydraulics, soil, vegetation, and animal interactions are difficult to inventory and analyze. This paper does not attempt to provide these answers. One standard rule is that management must be in-place to maintain or improve riparian vegetation before attempting revegetation. Without proper management, planting efforts could be destroyed, not to mention the time and money that could be lost. A second rule is that willow planting may not be a good option if there are no native willows in the vicinity. Careful reconnaissance of the areas upstream and downstream from the revegetation site selected may save a lot of effort. Planting willows can adversely interact with other natural forces to cause increased damage to the riparian zone. Some major problems to watch for are; high velocities, sharp curves, high vertical to near vertical or undercut banks, entire reaches bare of vegetation to waterline, and evidence of mass soil slumping. Mature willows can partially block or deflect currents adversely. If the mature basal size of the willows planted will block more than 10% of the surface width at normal flow, willows may not be the answer. After inventory and analysis indicates willows as an option, usually the entire problem reach is planted, not just parts of a curve. A continuous line of willows through the curve is important so that the water is not channeled behind the cuttings. This will destroy the planting altogether and most likely increase the damage to the eroded area you are trying to repair. Carefully look at the water flow before it reaches the curve. Where does the water enter the curve? Where does the water leave the curve? Where does the greatest force of water hit the reach? All of these questions affect the type of willow and planting method to be used.

Permits

Once you make the decision to rehabilitate a section of stream channel, your first course of action should be to notify the State Department of Water Resources, State Department of Wildlife, and the US Army Corps of Engineers. Normally any work done in a stream channel requires notification of these agencies and the issuance of permits before starting any work.

Willow Growth Type

Willows have several different growth types. It is important to pick the appropriate type to plant in different sections of the reach selected for rehabilitation. The best place to get this information is to look at willows growing in the general area. Observe the general types of willows and their location in relation to the stream. Willows come in all sizes, from large or small shrubs, to large or small trees. Some willows sucker profusely while others mature with a large dense basal area. Each basic type of willow grows in certain places along the stream channel. For example, creeping type willows are found and should be planted on inside curves of a stream channel. They grow where the force of the water is not directly on them. They should be planted at the toe of the opposite bank after it has been stabilized. Shrubby types would normally be planted on the outside curves of a stream channel as a continuous barrier. Plant the tree type willows up the bank from the shrubby type or right on top of the bank. The shrubby types provide protection for the tree types when planted in this manner. For the most part, small to medium size and creeping willows are used for planting. By observing and identifying these characteristics, the chance of success in revegetating a section of habitat in a riparian zone will be significantly increased.

Source of Willow Cuttings

Willows have been used extensively for riparian rehabilitation because of the ease with which they can be established from cuttings. The willow cuttings can usually be obtained from commercial nurseries or from native stands located near the rehabilitation site. The Interagency Riparian/Wetland Plant Development Project, in addition to other Plant Materials Centers around the United States, conduct extensive testing with native willows collected from their service area that have similar climate, soils, and topography. Once they have found a willow that meets the criteria they have selected to test, the willow is given a cultivar name and released. Commercial nurseries and growers then propagate the willow on a much larger scale for sale to the public. As with any released plant material, the cultivar name is the key to getting a plant that is adapted to a described area and that it will behave predictably in the same conditions it was tested under. All named cultivars have documentation that describes their growth characteristics, performance, and selection criteria. This ensures that they are the same stock as the PMCs originally tested. Asking for a released willow cultivar by name means you will know exactly what you are getting and what it will do. Native willow stands located near the rehabilitation site are another source of cuttings to consider besides commercial nurseries. Here you can see exactly what the willows look like and you know that they will grow on the site. Make sure that the native stand will not be denuded or destroyed by your cutting activity. From your prior planning, you know exactly how many cuttings you need so you should be able to tell if the stand can sustain your pruning effort.

Handling and Storage

Cuttings are usually taken from live but dormant willows either in late fall or very early spring before the buds start to break. The cuttings taken in late fall are usually stored in a cooler at -1.7 to 1.1 °C (29-34°F) until just before planting. Cuttings can be stored for several months in a cooler. At the Interagency Riparian/Wetland Plant Development Project, cuttings have been stored for as long as 6 months and still had excellent survival. Where a cooler is not available, both the harvest of cuttings and the actual planting should be scheduled for early spring. Keep the cuttings cool and slightly moist at all times. They should also be stored in a dark environment until you are ready to plant them.

Cutting Diameter

Willow cuttings should generally be at least 1.9 cm (0.75 in) in diameter or larger depending upon the species of willow you are planting. For example, creeping or spreading willows will rarely get much bigger than 2.5 cm (1 in) in diameter, but tree-type willows can be several decimeters in diameter. The larger diameter cuttings have more energy and stored reserves than the smaller diameter cuttings. Studies have indicated that the highest survival rates were obtained using cuttings that were between 1.9 cm (0.75 in) and 7.6 cm (3 in) in diameter. At the Interagency Riparian/Wetland Plant Development Project, we have also tested cuttings as large as 20.3 cm (8 in) and have had excellent success. The deciding factor in terms of the diameter is normally the planting method you have decided to use. Bigger diameter and length will be needed for more severe erosion and greater depth to water.

Cutting Length

The length of the willow cutting is largely determined by the depth to the lowest water table of the year and the erosive force of the stream at the planting site. Generally, the best rule of thumb is to make sure that 20 cm (7.9 in) of the cutting are in the lowest water table of the year, 3-4 buds are above the ground, and no less than 1/2 the total length is in the ground. The willow cutting will normally grow in these conditions. If you are trying to plant for bank stabilization, the cutting should extend 0.6-0.9 m (2-3 ft) above the ground to provide immediate protection as it leafs out. If you are planting in an area that will be subject to the erosive force of moving water, the cutting should be planted as much as 0.9-1.8 m (3-6 ft) into the ground. If it is not this deep, the moving water can erode around the cutting and actually rip it out of the ground. Some of the Interagency Riparian/Wetland Plant Development Project tests show that even with root systems as long as 4.5-9.1 m (15-30 ft), the erosive power of the stream can rip a short cutting out.

Harvest of Cuttings

Once you have selected the cutting size, harvest location, and the site you want to plant, you are ready to start cutting. Lopping shears, pruning shears, a small wood saw, or a chain saw can all be used effectively to harvest cuttings. Again, the size of the cuttings will determine what you use to cut them. Generally, you want to use green wood rather than older more mature wood (always use less than 12 year old wood). Stay away from suckers as much as possible because they don't have the stored energy reserves necessary to consistently sprout once they have been planted. As you cut the planting stock off the mother willow, be aware of what the willow will look like after you are done. You certainly don't want to kill it and you don't want it to look like a buzz-saw has gone through it. Selectively pick branches that will not overly affect the willow health and appearance once they are removed. Trim off all the side branches so that the cutting is one single stem. Generally, experts agree that the apical bud (the bud at the end of the branch) draws too much energy from the stored reserves and this will negatively affect survival of the cutting. It also contains the flowering parts of the plant. You want the plant to sprout roots and stems, not flowers. In addition, as you near the apical bud, the diameter of the cutting decreases to an unacceptable size. So, it is best to cut the apical bud plus about 0.3-0.6 m (1-2 ft) off the cutting before planting it.

Sealing of Harvested Cuttings

One of the most important steps in this entire process is the identification of the TOP of the cutting. If the cutting is planted upside down, it will decrease your establishment success and most, if not all, of your harvesting and planting effort will be wasted. To identify which end is

the top of the cutting, look at the leaf scar and any emerging buds. Buds emerging from the leaf scar pointed up. Another key is that the stem is usually a smaller diameter near the top of the cutting, but this is not always obvious. The leaf scars are the best, most reliable key. When you are sure that you have identified the top of the cutting, you need to seal it. Experience has indicated that dipping the TOP 2.5-5.0 cm (1-2 in) of the cutting into a 70-30 mix of cheap white latex paint and water, prevents excessive loss of water from the cutting. This method is cheap and surprisingly easy to do, yet it has proven to produce reliable results. An additional benefit to painting the top is that planting crews will know which is the top of the cutting and which end should go in the ground.

Pre-planting Treatment of Cuttings

The Interagency Riparian/Wetland Plant Development Project receives many questions on whether the cuttings should be fertilized, treated with rooting hormone, or treated with a fungicide. Generally, the answer is no to all three when we are talking about willow or cottonwood cuttings. Our tests show that these treatments do not significantly affect the rooting of these cuttings. Willows and cottonwoods are very easy to root without any special handling. These treatments will increase the cost, manpower requirements, and the time necessary to plant a section of stream channel without significantly affecting survival.

Now, you are ready to plant the cutting in the ground. After you have done all your homework and you have made all the decisions relative to planting the cuttings, you take the cuttings out of storage and transport them to the planting site. Before you plant them, you should soak the bottom 1/2 of the cutting in water for 2 to 7 days. Soaking initiates the growth process within the inner layer of bark in willows. Remember, that you are harvesting the cuttings when they are dormant. Soaking has been shown to significantly increase the survival rate of the cuttings.

Planting Willows

Once the cuttings are treated, you are ready to put the cuttings in the ground. A tractor-mounted post hole digger, a one or two man post hole digger, a soil auger, a large bar, a planting shovel, or just pushing the cutting into moist soil have all been used successfully in the past to plant willow cuttings. When selecting the appropriate method, you need to keep several things in mind. First, it is essential to have good contact between the cutting and the soil in order for the roots to sprout. Air pockets around the cutting will kill the roots as fast as anything. So, digging an 30.5 cm (12 in) hole for a 1.9 cm (0.75 in) cutting means that you must be very careful to tamp the soil around the cutting firmly several times as you fill in the hole. The process is very similar to planting a fence post. Second, the depth that you need to plant the cutting eliminates several methods. The deeper you have to go, the easier it will be with a power auger or a soil auger. Third, the surface layer of soil at the planting site will eliminate several methods. For example, if the surface layer is sandy, it will fill in the hole as you dig it. If the surface layer is clay, there may not be enough soil to pack around the cutting once you have placed it into the hole. Additional soil might have to be brought in or found nearby. There are no easy answers here, trial and error before you start planting will probably be necessary. The point here is to do your homework before you bring the fragile cuttings out of storage to plant.

Spacing Considerations

Space the individual willow cuttings about 0.3-0.9 m (1-3 ft) apart for shrubby types and about 1.8-3.7 m (6-12 ft) apart for tree types. In those areas where you expect erosive action from moving water in the stream, plant the shrubby types 0.3 m (1 ft) apart to better protect the banks. Don't be afraid to crowd them a little because they will not be stressed for lack of water and they

will provide better protection to the bank this way. If you are not sure of exactly how to arrange the planting, go back and look at some of the local willows again. See how they naturally lay according to creeping, shrub, and tree type.

Management and Maintenance

It is important to emphasize management again. You need to preserve or initiate management that will keep, maintain, and improve these willows and all your riparian vegetation. This is as important as the planting itself to rehabilitate the riparian area. Some maintenance will be needed on the site for several years after the planting, so don't just plant and walk away. If you don't replant the first couple of years, your continuous barrier will be jeopardized. Once water gets behind the planted willow line, it is extremely difficult to repair the damage. In addition, replanted willows will not have as much competition from the adjacent willows if they are closer to the established willows' size. Monitoring of the site is necessary so that any dead organic material (i.e. old logs, dead root masses, branches, etc.) can be removed before the stream flow is deflected or gravel bars started. It is much easier to prevent this kind of damage than it is to repair it. As the willows age and start to develop their grow patterns, some of them will probably need to be trimmed or cut to stimulate smaller and denser growth. Normally, any subsequent trimming should be done in the dormant season so the willows will not be slowed during the growing season.

Benefits

Now all you have to do is stick them in the ground and watch them grow. Watch them sprout and protect those eroding stream banks. Watch them leaf out, provide shade, and increase cover which will in turn improve the fish and wildlife habitat. Watch them increase the value of your property. Watch them improve the water quality of the stream for miles downstream. All of these benefits will come just because you have taken a little time and exerted a little effort to plant a few willows.

Additional Information

The Interagency Riparian/Wetland Plant Development Project has produced a number of technical papers that discuss various aspects of riparian and wetland planting, seed collection, propagation, and establishment. The following is a list of those papers:

Riparian/Wetland Project Color Brochure - What is the Interagency Riparian/Wetland Plant Development Project?

Riparian/Wetland Project Information Series

No. 1 - Planting techniques for vegetating riparian areas from the Aberdeen Plant Materials Center.

No. 2 - Selection and Acquisition of Woody Plant Species and Materials for Riparian Corridors and Shorelines.

No. 3 - Use of Willow and Cottonwood Cuttings for Vegetating Shorelines and Riparian Areas.

No. 4 - How to Plant willows and Cottonwood for Riparian Rehabilitation.

No. 5 - Collection, Establishment, and Evaluation of Unrooted Woody Cuttings to Obtain Performance Tested Ecotypes of Native Willows and Cottonwoods.

No. 6 - Seed and Live Transplant Collection Procedures for 7 Wetland Plant Species.

No. 7 - Use of Greenhouse Propagated Wetland Plants Versus Live Transplants to Vegetate Constructed or Created Wetlands.

No. 8 - Constructed Wetland System For Water Quality Improvement Of Irrigation Wastewater

Idaho NRCS PM Technical Note

No. 6 - The Stinger, a tool to plant unrooted hardwood cuttings of willow and cottonwood species for riparian or shoreline erosion control or rehabilitation.

No. 23 - How to Plant Willows and Cottonwoods for Riparian Rehabilitation. (This Tech Note describes planting willows and cottonwoods in riparian revegetation in much greater detail and includes references from the scientific literature.)

If you would like a copy of a particular Information Series technical paper or Technical Note, write or call me:

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